



PROJECT PROGRESS REPORT

**PREPARED FOR THE ALASKA ENERGY AUTHORITY BY
THE ALASKA CENTER FOR ENERGY AND POWER**

PROJECT TITLE: *Round 2: Emerging Energy Technology Fund – Data Collection*

REPORTING PERIOD: 4th Quarter 2014

DATE OF REPORT: January 15, 2015

GRANT RECIPIENT: Alaska Center for Energy and Power
University of Alaska Fairbanks
814 Alumni Dr.
Fairbanks AK 99775-5910

EETF Round 2 Projects

Air Source Heat Pump, CCHRC

ACEP staff member Chris Pike visited the CCHRC heat pump installations in Juneau and Wrangell in December of 2014 to observe the instrumentation and communicate with project stakeholders.

In Juneau, the two separate air-to-water heat pump units were observed at the home of Jim Rehfeldt. One unit is dedicated to domestic hot water and space heating, while the other is a dedicated space heating unit. Jim confirmed the information explained in the data monitoring plan.

“Heat pump 2 is dedicated to heating hot water, but when the outside temperature is below 30°F and there is no hot water demand, it operates with Heat Pump 2 for space heating. Heat pump 2 supplies exclusively space heating. The home primarily uses air handling units with a few supplemental in-floor heat distribution systems.”

Overall Jim has been very happy with the systems' performance. The systems have been installed for over a year, and they have not required any maintenance. They are plumbed into three different air handling zones as well as radiant floor heating. However, he doesn't think the radiant floor heating does much due to the cooler temps that the heat pumps put out as opposed to his previous oil boiler.

Jim has calculated about 13% ROI, 18% when \$7000 AHFC rebate is taken into account. Simple payback is about 6.5 years.

Instrumentation was high quality, and thermistors were installed in monitoring wells which were plumbed into the system and insulated.



Figure 1. A wide angle picture of the indoor portion of the heat pump units and associated plumbing.

The data collected to date is shown in Figure 2. Heat pump 1 (HP 1) has a noticeably lower coefficient of performance (COP) than Heat Pump 2 (HP 2). HP 1 is dedicated to domestic hot water when the air temperature is above 30 degrees Fahrenheit. When the temperature is above 30 degrees, HP 1 is lightly loaded, and while the COP numbers shown in the graph are on the low side, little energy is being consumed. HP 2 is dedicated to space heating and generally has higher COP values between 2 and 3.

The HP 2 COP values tend to follow the outside air temperatures. Heat pumps run most efficiently when fully loaded.

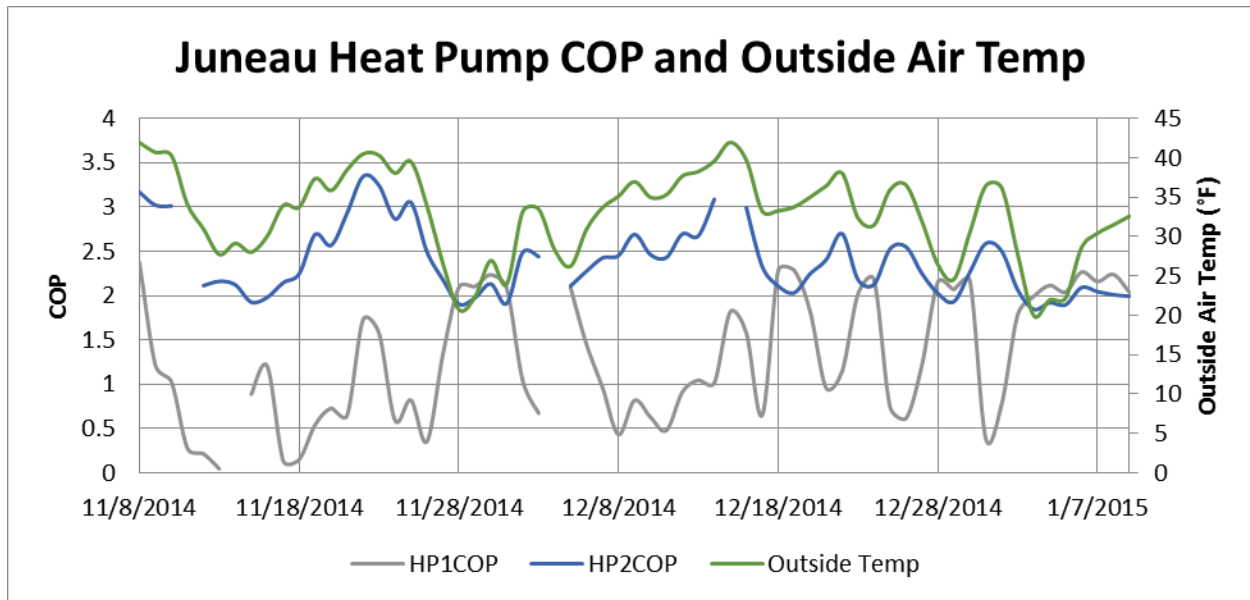


Figure 2. The average daily COP for the air-to-water heat pumps installed in Juneau are shown with outside air temperature.



In Wrangell, Chris met with Wrangell Light and Power manager Clay Hammer. The minisplit air-to-air heat pump being studied in Wrangell is installed at the utility office where it is closely monitored (Figure 3). There is an additional heat pump that was installed at the same time in city hall to serve as an example to the public about what types of heat pumps are possible. Overall both heat pumps are working well.

Clay reports that due to the low grade heat produced, the heat pump takes a while to heat up the building. Consequently, the utility office leaves it set at 70 degrees Fahrenheit and does not turn it down at night. During colder parts of the year, the heat pump doesn't turn off. There are three temperature sensors on the air intake and three on the air delivery side. A pitot tube anemometer is attached to the intake and was calibrated with a duct blaster by CCHRC.

Figure 3. The exterior portion of the Wrangell heat pump.

Performance data for the Wrangell heat pump is shown in Figure 4. The system appears to be performing well. Early in the season the heat pump was not being used for heating purposes and the COP numbers before mid-October reflect this. Recent COP data indicate the heat pump has been performing with a COP between 2.5 and 4. This is in line with expectations. Figure 4 also shows how closely the COP mirrors the outside air temperature.

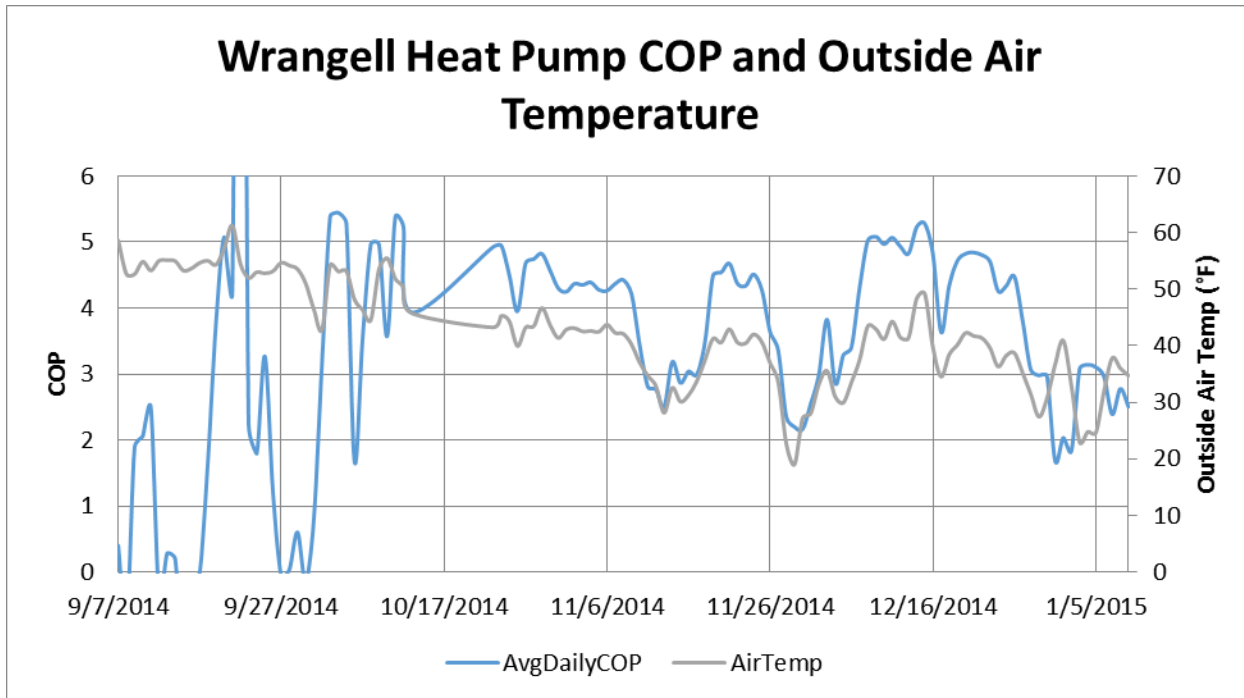


Figure 4: The Wrangell heat pump average daily COP and outside air temperature

A site visit will not be made to the Dillingham heat pump being used in this study. The heat pump is being closely monitored by the homeowner Tom Marsik, who teaches a renewable energy course at the University of Fairbanks. The heat pump is installed in what the Guinness Book of World Records has coined “the world’s tightest house,” which is also probably among the best insulated. As would be expected, the heating loads in this house are extremely low. The Dillingham heat pump data is shown in Figure 5. The COP numbers shown for this unit are lower than the other units that have been discussed. Further analysis will take place after a winter’s worth of data is measured, but a brief examination reveals that when the unit cycles on, it runs for a short amount of time before the necessary heat energy is delivered to the house. The short run times likely contribute to the lower COP values. Still, the COP values are all greater than 1, indicating the unit is more efficient than regular electric resistance heating.

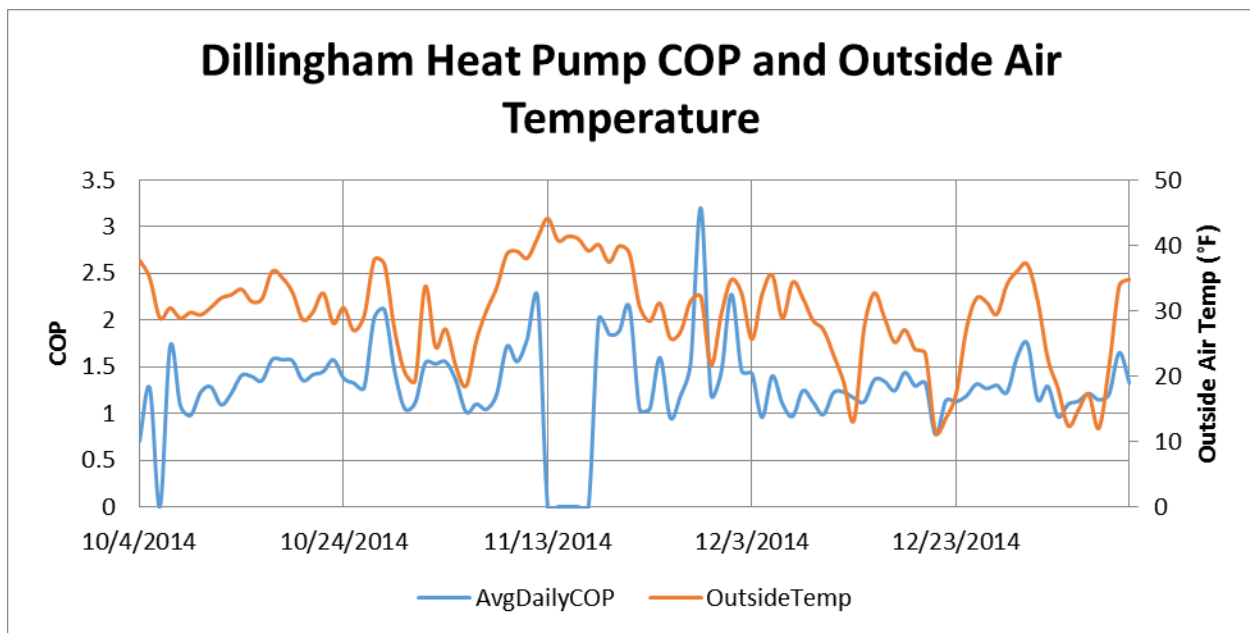


Figure 5: The Dillingham heat pump average daily COP is shown with the average daily outside air temperature.

Trans-Critical CO₂ Heat Pump, Alaska Sea Life Center

Darryl Schaefermeyer of the Alaska Sea Life Center indicates that the CO₂ heat pump project is still moving forward according to plan. He expects the design will be available for review in early January. At this time the project has not been installed and there is no data to review.

The Alaska Sea Life Center has been in contact with the heat pump manufacturer and at this time a 14-18 week lead time will be necessary before the heat pumps can be delivered.

Multi-Stage Energy Storage System, Chugach Electric Association

According to Chugach, they are still waiting to receive the grant agreement from AEA.

St. Paul Flywheel Demonstration, TDX

TDX has installed their system in St Paul. It is operational and FTPing data to ACEP servers daily. TDX is being extremely generous with their data and providing details of the entire powerhouse rather than just the flywheel. ACEP is currently working with TDX to arrange a site visit.